charts of the Atlantic Ocean, with an explanatory text, at the cost of the respective institutions of Copenhagen and Hamburg, and to recommend other institutions to contribute materials for the work, if they can.

(*g*) M. Tietgens, Chairman of the Great Northern Telegraph Company, submitted to the Committee a plan for a cable to connect Iceland and the Faroes with Europe, the expense to be met by the receipts from meteorological telegrams. The Committee, while recognizing the very great importance which information coming from Iceland and the Faroes must possess in relation to the issue of storm warnings and forecasts in Europe, felt that they were not in a position to express an opinion on the practical execution of the project.

(*h*) The Sub-Committee nominated at Berne (MM. Mascart and Wild) submitted specimens of their proposed International Reduction Tables. It was resolved to print a full page of each of these tables, with explanations, and submit them to meteorologists for their opinion, with the view of subsequently publishing the tables by means of subscriptions from the different institutes.

(*i*) M. van Rysselberghe's proposal to communicate by wire the indications of his instruments at out stations to central offices was considered, and that gentleman was requested to draw up and publish a detailed scheme for its execution.

(*j*) A Committee was nominated, consisting of M. de Brito Capello, Rev. Clement Ley, and Prof. Hildebrandsson, to draw up a scheme of instructions for the observations of "cirrus" clouds.

(*k*) It was resolved that the prospects of the preparation of a general catalogue of Meteorological Bibliography were not favourable to its execution, and that the only action for the Committee to take was to invite the heads of the different institutes to prepare catalogues of the meteorological literature of their respective countries.

The Members of the Committee were most hospitably entertained during their stay in Copenhagen. They were honoured with an invitation to dine with the King on the 5th inst., and on the following day an excursion was organised for them by the Marine Ministry to Friederichsborg and Elsinore, which was fortunately favoured with fine weather.

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## *THE SMOKE ABATEMENT INSTITUTE*

AT a meeting held at Grosvenor House, under the presidency of His Grace the Duke of Westminster, K.G., on July 14, at which the Reports of the recent Exhibitions in London and Manchester were presented, and the medals distributed to successful exhibitors, the following resolution was moved by Prof. Abel, C.B., F.R.S., seconded by Mr. J. Norman Lockyer, F.R.S., and carried unanimously:—

"That it is desirable that the work thus far carried on by the Smoke Abatement Committee be continued, and for that purpose a Smoke Abatement Institute be formed."

The chief objects of the proposed Association will be:—

(*a*) To promote the abatement of coal smoke and other noxious products of combustion in cities and other places, in order to render the atmosphere as pure and as pervious to sunlight as practicable.

(*b*) To check the present serious waste of coal, and the direct and indirect loss and damage accompanying the over-production of smoke and noxious products of combustion.

Extended powers will be taken for carrying out the objects of the Association by the following, among other means, viz.:—

1. By promoting and encouraging the better and more economical use of coal and coal products, the selection of suitable fuel, and the general improvement in producing, applying, and using heat and light for domestic and industrial purposes.

2. By conducting tests of smoke-preventing apparatus and fuels in manufacturing towns as well as in London.

3. By reporting on tests, granting awards for approved fuels, methods, or apparatus; by lectures, printing, publishing, and circulating statistics and other information for the guidance of local authorities, inventors, manufacturers, and others; and by giving instruction to workmen, servants and others in the use of new appliances, &c.

The terms of membership are one guinea per annum, or such larger sum as members may voluntarily choose to contribute. No liability will be incurred by becoming a member beyond a guarantee of one guinea, payable, if required, in the event of the termination of the Association; and any member can withdraw from the Association by giving notice of his wish to do so.

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## *THE COLOURS OF FLOWERS, AS ILLUSTRATED BY THE BRITISH FLORA*[1]

### IV.—*Degeneration*

THE cases already detailed lead us gradually up to the consideration of those very degenerate flowers whose structure has become completely debased, and especially of those which have green perianths instead of coloured corollas. As a rule, evolutionists have taken it for granted that green flowers were the earliest of any, and that from them the coloured types have been derived by insect selection. But if the principles laid down so far be correct, then it is obvious that, since all petals were originally yellow, green petals must be degraded, or at least altered types. Of course, the flowers of gymnosperms (in their blossoming stage) are mostly composed of green scales or leaves; and so it no doubt remains true that all flowers are ultimately descended from green, or greenish, ancestors. But if petals are by origin modified stamens, it will follow that all corollas at least were once coloured; and we shall probably see reason in the sequel to extend the principle to all perianths whatsoever. Without insisting upon the rule too dogmatically, so as to embrace every kind of angiosperm, we may, with some confidence, assert that wherever a flower possesses a rudiment of a perianth in any form, it is descended from coloured and entomophilous ancestors.

The Composites are, perhaps, in some respects, the very highest family of entomophilous flowers now existing on the earth. Their very structure implies the long and active co-operation of insect fertilisers. They could not otherwise have acquired the tubular form, the united corolla, the sheathed anthers, the compound heads of many-clustered florets. That originally green flowers could attain to this stage of development, and yet remain green, is simply inconceivable. But the Composites contain also some of the most degraded flower types in all nature. Beginning with such forms as the common groundsel (*Senecio vulgaris*), which has an inconspicuous yellow rayless head, specially adapted to self-fertilisation, we go on to plants like the *Artemisias*, with small greenish florets, which have taken, or are taking, to wind-fertilisation. Still more degraded are the *Antennarias*, *Gnaphaliums*, and *Filagos*, whose mode of fertilisation is problematical. And at the very bottom of the scale we get the little green *Xanthium*; so degenerate a form that its connection with the other Composites can only be traced by means of several intermediate exotics, in every stage of progressive degradation. Such conclusive examples clearly show us that green flowers may occur as products of degradation even in the most advanced families.

*Adoxa moschatellina* is another excellent specimen of a green corollifloral blossom. This pretty little plant is closely allied to the honeysuckles and ivies; but it has somehow acquired a light green corolla, in place of a white or pink one. It is still entomophilous, and scantily secretes honey, so that the reason of the change cannot be immediately pointed out. Perhaps its very inconspicuousness saves it from the obtrusive visits of undesirable insect guests. The flowers of *Hedera helix*, common ivy, are also yellowish green. In the allied family of *Umbelliferæ* many flowers have declined to similar greenish tints; but this can hardly be their primitive colour, as they have an inferior ovary, which marks high development. *Smyrnium olusatrum* in this family, and *Chrysosplenium* among the *Saxifragaceæ*, exhibit very well the steps by which green corollas or perianths may be produced from originally white or yellow flowers. Their high structural development obviously negatives the notion that they are primitive green flowers; and we must necessarily conclude that they have become green for some special functional purpose of their own.

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[1] Continued from p. 350.

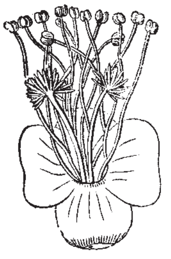

FIG 27.

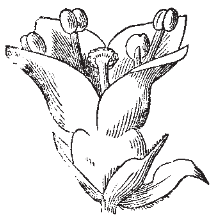

FIG. 28.

FIG. 27.—Single floret of *Poterium sanguisorba*, green and anemophilous. FIG. 28.—Single floret of *Sanguisorba officinalis*, purple and entomophilous.

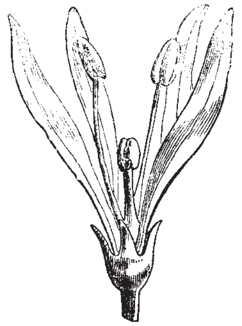

FIG. 29.—Single blossom of South European *Fraxinus ornus*, flowering ash, with calyx and four-lobed white corolla.

The orchids themselves, that most specialised of entomophilous types, show us other examples of flowers which have become more or less green; such as *Malaxis paludosa*, which has a yellowish tinge; *Liparis loeselii*, also yellowish; *Epipactis latifolia*, greenish brown; *Listera ovata*, grass-green; *Habenaria viridis*, yellowish green; and *Herminium monorchis*, pale greenish yellow. Why these highly-developed entomophilous blossoms should have found green suit them better than white, pink, or purple, it would be hard to say; but the fact remains indisputable; and it would be almost inconceivable that flowers of so high a type should have remained green all through the various stages of their long previous development. We may confidently set them down as products of incipient degeneration.

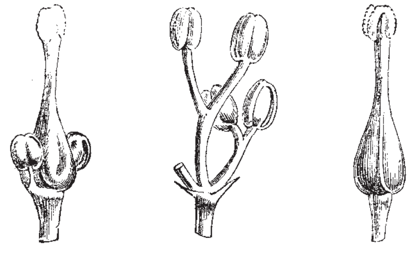

FIG. 30.—Three forms of naked flowers of British ash, *Fraxinus excelsior*, without calyx or corolla.

Among polypetalous flowers we get some equally interesting facts. *Helleborus viridis*, a doubtfully English ranunculaceous plant, has small green petals, employed as nectaries, and concealed by the large green sepals. It is entomophilous, and much visited by insects. Instead of being one of the least-developed *Ranunculaceæ*, however, it is one of the most advanced and highly differentiated types. In the lily family, again, the onion genus (*Allium*) is a small, and often degraded, group, whose more retrograde members produce green in place of purple or white flowers. In *Allium vineale*, and some others, the flowers often degenerate so far as to become small caducous bulbs. Here, degeneration is the only possible solution of the problem presented by the facts.

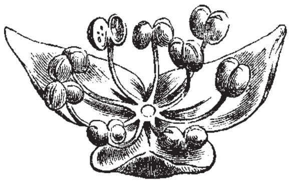

FIG. 31.

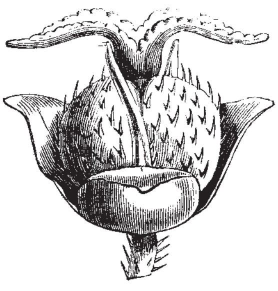

FIG. 32.

FIG. 31.—Single male flower of dog's mercury, green. FIG. 32.—Single female flower of dog's mercury, green.

More frequently, however, reversion to wind-fertilisation (probably the primitive habit of all flowering plants) has produced green blossoms among angiosperms. This may result in two or three distinct ways. Either the corolla may become dwarfed and inconspicuous, or it may coalesce with the sepals or calyx-tube, or it may cease to be produced altogether. We may take the plaintains (*Plantago*) as a good example of the first-named case. Here we have tubular florets with four corolla-lobes, apparently descended from some form not unlike *Veronica* (though with four cells to the ovary) but immensely degraded. The corolla is thin and scarious, and its lobes are tucked away at the sides, so as not to interfere with the stamens and style. These, again, as in most wind-fertilised plants, hang out freely to the breeze; so that the whole spike when flowering shows no signs of a corolla from without, but seems to consist entirely of scales, stamens, and styles, just like a sedge or

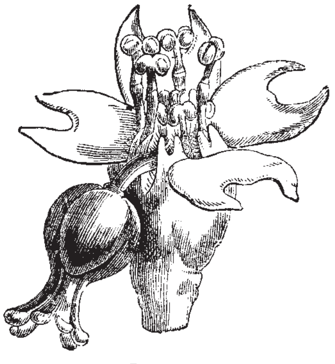

FIG. 33.

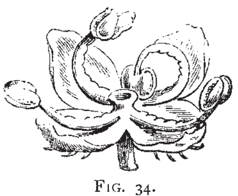

FIG. 34.

FIG. 33.—Cluster of male and female flowers of spurge, green, in a common involucre: the male flowers reduced to a single stamen each, jointed where the filament joins the peduncle. FIG. 34.—Male flower of nettle, green, the stamens opposite the sepals.

grass-plant. It is impossible, however, to examine the functionless corolla without coming to the conclusion that *Plantago* must be descended from an entomophilous ancestor. Indeed, *P. media* still to some extent lays itself out to attract small flies, by which it is even now often visited and fertilised.

The *Rosaceæ* offer some good examples of green flowers in which the petals have become quite extinct. Some of them are entomophilous, and some anemophilous. *Alchemilla vulgaris* (lady's mantle) is one of the former class. It is a degraded representative of the same group as agrimony; but it has lost its petals altogether. That it is a late, not a primitive form, is shown by its very reduced carpels, and its small number of stamens. *Alchemilla arvensis* (parsley-piert) is an extremely debased moss-like descendant of some similar ancestor. It has tiny green petalless axillary flowers, self-fertilised, but occasionally visited by minute insects. Not far from these may be placed *Poterium sanguisorba* (Fig. 27), another degraded type, which has become anemophilous. This flower, too, is green, and has no petals; it usually possesses but one carpel, and it is altogether a clearly debased bisexual form. Its stamens are numerous, and they hang out to the wind, so do also the feathery stigmas in the female flowers, to catch the pollen from neighbouring heads. But the closely-allied *Sanguisorba officinalis* (Fig. 28) is evidently an entomophilous variation on the same ancestral form; for it resembles *Poterium* in every respect except in its flowers, which have very few stamens, inclosed in the purple calyx-tube. This interesting case shows us that when a flower has once lost its petals and become anemophilous, it cannot re-develop them if it reverts to insect fertilisation, but must acquire a coloured calyx instead. The same lesson is perhaps elsewhere enforced by *Glaux maritima* among the *Primulaceæ*, and by *Clematis* among the *Ranunculaceæ*.

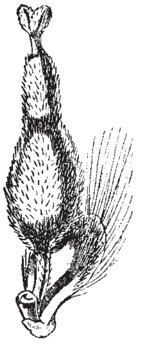

FIG. 35.

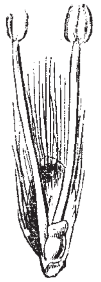

FIG. 36.

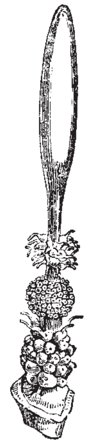

FIG. 37.

FIG. 35.—Female flower of willow, reduced to a scale and an ovary. FIG. 36.—Male flower of willow, reduced to a scale and two stamens. FIG. 37.—Naked flowers of the Arum, each consisting of a single ovary or a few naked stamens.

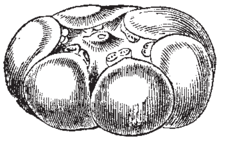

FIG. 38.—Single flower of *Acorus*, with three sepals, three petals, six stamens, and an ovary.

Mr. Darwin remarks that anemophilous flowers never possess a gaily-coloured corolla. The reason is clear. Such an adjunct could only result in the attraction of stray insects, which would uselessly eat up the pollen, and so do harm to the plant. Hence, when flowers revert to wind-fertilisation, both disuse and natural selection cause them to lose their petals, and become simply green.

In practice, however, it is often hard to distinguish between the casually entomophilous, the self-fertilised, and the really anemophilous species; and they are so intermixed that it may perhaps be best to consider them together. For example, the common ash (*Fraxinus excelsior*) belongs to a gamopetalous family, the *Oleaceæ*, and is closely related to the white privet (*Ligustrum vulgare*), which has conspicuous white flowers. But many large trees, owing, perhaps, to their long life, and consequent less necessity for producing many seeds, tend to lose their petals; and this is remarkably the case among the olive group. The shrubby species have usually flowers with a four-lobed corolla; and so have many of the southern arboreal forms (Fig. 29); but the northern trees, like our ash, have lost both calyx and corolla altogether, each naked flower consisting only of two stamens, with a single ovary between them (Fig. 30). In appearance their blossoms seem of much the same sort as the wind-fertilised catkins and oak-kinds. Nevertheless, they are entomophilous, for their pollen, their arrangement in large masses, and their dark purple colour, sufficiently serve to entice numerous insects.

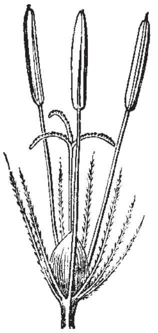

FIG. 39.

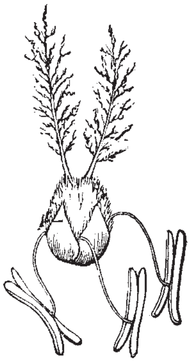

FIG. 40.

FIG. 39.—Flower of *Scirpus*, a sedge, with hypogynous bristles representing the calyx and corolla. FIG. 40.—Flower of a grass, with calyx removed, showing two lodicules or rudimentary petals, three stamens, and an ovary with two stigmas.

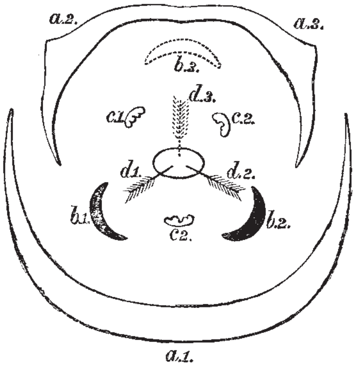

FIG. 41.—Diagram of grass flower, showing its relation to a lily: *a*, the calyx, represented by $a_1$, the flowering glume or outer palea, and $a_2$ and $a_3$, the inner palea, composed of two connate sepals; $b_1$ the corolla, represented by $b_1$ and $b_2$, the lodicules, $b_3$ the third petal, being obsolete; $c_1$ the stamens; $d_1$ the pistil, $d_1$ and $d_2$ the existing stigmas, $d_3$ being obsolete. The whole flower is thus abortively developed on the inner side next the axis.

The spurges (*Euphorbiaceæ*) are a very interesting family of the same sort, exhibiting every gradation from perfect corolliferous blossoms to the most degraded flowers in all nature. Our English species have no true petals; but some exotic forms are truly dichlamydeous;

and from them we can trace a gradual decline, through plants like dog's mercury (*Mercurialis perennis*), which has a green calyx, but no corolla (Figs. 31 and 32), to very degenerate green blossoms like our own spurges (*Euphorbia*), which consist of several extremely simplified flowers, collected together in a common involucre. Each separate male floret is here reduced to a single stamen, raised on a short peduncle, and with a distinct joint at the spot where the petals once stood (Fig. 33). It is worthy of notice, too, that when these degenerate, but still entomophilous, green flowers have found it desirable to attract insects by developing new coloured surfaces in place of the lost corolla, they have not done so by producing a fresh set of petals, but have acquired coloured bracts or involucres instead, as in the well-known *Iatrophas* and *Poinsettias* of our hot-houses. This instance is exactly analogous to that of the *Sanguisorba*. It tends to show that petals are not developed from bracts, but from altered stamens.

From cases like these we go down insensibly through all the ranks of the dicotyledonous *Monochlamydæ*. In the *Paronychiaceæ*, for example, we get an order closely allied to the *Caryophyllaceæ* (especially to *Polycarpon*); and in one genus (*Corrigiola*) the flowers have small white petals, which certainly aid in attracting insects. But in *Herniaria* the flowers are quite green, and the petals are reduced to five small filaments, thus partially reverting to their presumed original character as stamens. In *Scleranthus* the filaments are often wanting, and in some exotic species altogether so. The *Amarantaceæ*, unrepresented in Britain, approach the last-named family very nearly, but have the petals altogether obsolete; and in many cases, such as Prince's feather (*Amaranthus hypochondriacus*) and Love-lies-bleeding (*A. caudatus*), the calyx becomes scarious and brightly coloured. The *Chenopodiaceæ* are other near relations, in which also the petals are quite obsolete; and in most of them the perianth (or calyx) is green. In *Salicornia* it has become so embedded in the succulent leafless stem as to be almost indistinguishable. The *Polygonaceæ*, on the other hand, are a group of plants, allied to *Chenopodiaceæ*, but with a row of degraded petals, and a strong tendency to produce coloured perianths, analogous to that which we observed in *Sanguisorba*. The flowers of *Rumex*, the docks, are sometimes green, sometimes red; those of *Polygonum* are pale-green, white, or pink. *Rumex* is sometimes, *Polygonum* constantly, fertilised by insects.

There remain doubtful, then, among green Dicotyledons, only the highly anemophilous families, like the nettles (*Urticaceæ*), and the catkin-bearing trees (*Amentiferæ*). The former have a well-developed calyx, at least to the male flowers (Fig. 34), and it is difficult to see how any one who compares them with *Scleranthus* or *Mercurialis*, known descendants of petaliferous forms, can doubt that they too are degenerate types. Indeed, the mere fact that the stamens are opposite to the lobes of the calyx, instead of alternate with them, in itself shows that a petal-whorl has been suppressed; as is likewise the case in the goose-foots and many other doubtful instances.

As to the *Amentiferæ*, *Cupuliferæ*, and other catkin-bearers, at first sight we might suppose them to be primitive green anemophilous orders. But on closer consideration, we may see grounds for believing that they are really degenerate descendants of entomophilous plants. In the alder (*Alnus*) the male catkins consist of clustered flowers, three together under a bract, each containing a four-lobed perianth, with four stamens within. These little florets exactly resemble, on a smaller scale, those of the nettle; and the stamens here, again, are opposite to the calyx-lobes, which of course implies the suppression of a corolla. In the beech (*Betula*) the three florets under each bract are loosely and irregularly arranged; and in the male hornbeam (*Carpinus*) and hazel (*Corylus*) the perianth is wholly obsolete. All these are probably quite anemophilous. The willows (*Salix*), on the other hand, have become once more entomophilous (Figs. 35 and 36); and they are much visited by bees, which obtain honey from the small glands between the florets and the axis. Degenerate as these last-named species undoubtedly are, they may be connected by a regular line of illustrative examples (not genetically) through the beech, alder, nettle, goosefoot, *Scleranthus*, *Herniaria*, and *Corrigiola*, with such perfect petaliferous types as the pinks, and ultimately the buttercups.

Among Monocotyledons, the very degraded little entomophilous flowers of the *Arum* (Fig. 37), enclosed in their green spathe, are often spoken of as though they represented a primitive type. In reality, however, they are degenerate dichlamydeous blossoms, linked to the lilies by *Acorus* (Fig. 38), which has numerous hermaphrodite flowers, each with a perianth of six scales, two rows of stamens, and a two-celled or three-celled ovary. Here, again, the green flower is obviously of late date.

What, then, are we to say about the anemophilous Monocotyledons, the great families of the sedges and grasses? Surely these, at least, are primitive green wind-fertilised flowers. Dogmatically to assert the contrary would, indeed, be rash with our existing knowledge; yet we may see some reason for believing that even these highly anemophilous types are degenerate descendants of showy petaliferous blossoms. For, if the origin here assigned to petals be correct, it becomes clear that the *Juncaceæ*, or rushes, are only *Liliaceæ* in which the perianth has become dry and scarious. Some rushes, such as *Luzula*, approach very closely in general character to the grasses; and they also show themselves to be higher types by the further development of the ovary, and the decreased number of seeds. *Eriocaulon* and the *Restiaceæ* give us a further step towards the grass-like or sedge-like character. Some of the *Cyperaceæ* show apparent relics of a perianth in the bristles which surround the ovary, especially in *Scirpus* (Fig. 39); and perhaps the perigynium of *Carex* may represent a tubular perianth, though this is far more doubtful. In the grasses (*Gramineæ*) the perianth is either altogether obsolete, or else is reduced to the paleæ with the hypogynous scales or lodicules (Fig. 40). According to the most probable view, the two paleæ represent the calyx (for the inner palea exhibits rudiments of two sepals, thus making up, with the outer palea, a single trinary whorl); while the lodicules represent two of the petals, the third (the inner one) being usually obsolete (Fig. 41). It is fully developed, however, in the bamboo. The connection is here less clearly traceable than in the *Amentiferæ*, but it is still quite distinct enough to suggest at least the possibility that even grasses and sedges are ultimately derived from entomophilous flowers.

Thus we are led, at last, to the somewhat unexpected conclusion that anemophilous angiosperms are later in development than entomophilous angiosperms, and are derived from them. Though the earliest flowering plants—the pines, cycads, and other gymnosperms—were undoubtedly anemophilous from the first, yet the probability seems to be that all angiosperms were originally entomophilous, and that certain degenerate types have taken later on either to self-fertilisation, or to fertilisation by means of the wind. Why this apparently retrograde change has proved beneficial to them it would be impossible properly to inquire here. We must content ourselves with noting that such degraded green flowers fall for the most part under one or other of four heads: (1) dwarfed or weedy forms; (2) submerged or aquatic forms; (3) forest trees; (4) grass-like or plaintain-like plants of the open wind-swept plains. That there are *no* primitive families of green or anemophilous angiosperms, it might perhaps be rash and premature to assert; but at least we may assume as very probable the principle that wherever green flowers possess any perianth, or the relic or rudiment of any perianth, or are genetically connected with perianth-bearing allies, they have once possessed coloured insect-attracting corollas. In short, green flowers seem always (except in gymnosperms) to be the degenerate descendants of blue, yellow, white, or red ones.

GRANT ALLEN

## *THE INSTITUTION OF MECHANICAL ENGINEERS*

THE town of Leeds is this year the place of the summer meeting of the above institution. This meeting, which commenced last Tuesday, has brought together a large number of engineers from all parts, who received a cordial welcome from the Mayor and a local committee, and have already gone through the greater portion of a very interesting programme. The president's address, as well as the papers read in the mornings, not less than the varied nature of the works thrown open in the afternoons, show the increasing connection of the engineer with the progress of civilisation and the comforts of daily life. Perhaps no better example of this could be found than in the town of Leeds. It is not necessary, and certainly it would not be very easy, to detail all the varied productions of Leeds, in which the engineer now plays an indispensable part. One or two interesting instances may, however, be cited from one of two papers read, to show to what extent manual labour is being replaced by the application of machinery.

As late as 1857 nearly all the clothing in Leeds was hand-made. At the present time a machine like a band-saw, but with a knife-edge, is employed to cut out the clothes. Some twenty-five pieces of double-cloth laid on each other are thus cut out at once. The parts are then sewn at the rate of from 700 to 2000 stitches a minute, and finally are ironed by a machine. Indeed, the several processes of cutting out, sewing together, binding, braiding, putting in sleeves, sewing on buttons, making button-holes, and ironing, are all done by machinery. The result is that between three and four million garments are annually made in Leeds alone. In the hat and cap industry, machinery is very largely used, the production being as much as 70,000 dozen per week. The manufacture of boots and shoes is carried on almost entirely by machinery, and though each boot passes through the hands of from six to twelve persons, such an article can be completely made in half an hour, from one to two million pairs of boots are being thus annually produced. The saving of manual labour, as seen by the above facts, presents a striking contrast to its waste as shown in the gigantic structures of the East; but, as the President in his address remarked, there is a reverse to the medal. The smoke nuisance yet overshadows much good work (in few places more than in Leeds), when it is admitted that it is altogether inexcusable, and cannot be too severely dealt with. Science and art have practically overcome it; and experience enables many to assert that money can be profitably laid out and yield good interest in the abatement of this unpardonable nuisance. It is to be hoped that one result of these meetings will be to do all that is possible that posterity may *not* "assuredly lay its finger upon the great blot of waste, and stigmatise our age as the Black Age, which has spoilt by careless, unnecessary, and selfish emissions of smoke and noxious gases, many a noble town and many a lovely spot on earth."

H. S. H. S.

## *PROFESSOR HAECKEL IN CEYLON*[1]

AFTER a fortnight devoted to the enjoyment of all that was new and strange in life in Ceylon, a fortnight fruitful in result to so shrewd and ardent an observer of nature and mankind, Professor Haeckel betook himself in earnest to the real object of his journey and looked about for the most favourable spot at which to conduct his zoological investigations. These were to be confined to that class of animal life which has been the object of Professor Haeckel's special study, namely, the Radiata, including star-fish, jelly-fish, etc., as well as corals, madrepores and other polypi. He hoped to make acquaintance with many new forms developed under the varying conditions of climate and coast formation and his letter in the August number of the *Rundschau* opens with a brief and succinct account of what these conditions are: "The conditions under which marine animals arrive at their fullest development are numerous and peculiar and it is by no means a matter of indifference what portion of the sea-coast we select for our investigations. The various qualities of sea water, its saltness, purity, temperature, rate of current and depth, must all be taken into account; and no less important, in fact often more so, is the nature of the neighbouring shore; whether it is rocky or sandy, barren or fertile and what is its geological formation. Then again, the amount of fresh-water drainage at any particular point, and the greater or less force of the waves have an important influence on the development of the marine fauna. For the classes in which I am more particularly interested: the Radiolites, Medusæ, Siphonophoræ, etc. the most favourable conditions are a deep, land-locked bay of clear still water, undisturbed by the influx of any great volume of fresh water and having strong currents setting towards the shore. Such a combination of favouring circumstances exists, for instance, in the Bay of Messina, the Gulf of Naples and other parts of the Mediterranean shore, long the chosen resort of zoologists. A glance at the map of India will show that such protected bays are of far rarer occurrence along its coast than on the many limbed and deeply indented shores of our glorious Mediterranean. The coast of Ceylon is provided with three only: the two beautiful harbours of Galle and Belligemma on the S. West coast and the magnificent isle-dotted Gulf of Trincomalee on the N. East. This last, Nelson declared to be one of the finest harbours in the world. The English government, quick to see the natural advantages of its dependencies and liberal in turning them to account, lost no time after the acquisition of Ceylon in forming Trincomalee into a fortified and well appointed harbour, by strengthening the forts already erected by the Dutch and by promoting in other ways the prosperity of the town. Much still remains to be done to make Trincomalee worthy of its position as the strongest harbour of refuge along the whole Indian coast. In the struggle in which England is sure sooner or later to be engaged for the possession of her Indian empire, this place will have an important part to play."

To so favourable a spot for the prosecution of his researches, the Professor naturally turned with a longing eye, but the difficulties of the long journey from Colombo to Trincomalee were insurmountable. There is no railway beyond Kandy, and from thence the journey must be made in bullock carts over bad roads and through thick forests. The season too was unfavourable; the heavy rains of the south-west monsoons having swelled the streams and carried away some of the bridges. The carts containing the sixteen chests of instruments, etc., necessary to the Professor's existence, would most assuredly have either stuck fast altogether or only arrived after much delay and with damaged contents. Nor were there any better prospects of a passage by sea. The little steamer usually forming the most direct means of communication for all places on the coast was laid up at Bombay for repairs, and the risk and uncertainty of sailing boats could not be thought of. With much regret, therefore, Professor Haeckel abandoned the idea of Trincomalee, and there only remained for him to decide between Galle and Belligemma. It is a proof at once of his ardour and

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